

Rethinking architecture as a catalyst for sustainability

Leena Thomas
University of Technology, Sydney, Australia
leena.thomas@uts.edu.au

Abstract: This paper proposes an alternate approach to considering the role of the architect against a backdrop of climate change, urban expansion and evolving technology, as the remit of architects is increasingly marginalized by other professions. Using the case study of architectural design studio investigations for the Master of Architecture at the University of Technology, Sydney on conflicted sites in Australia, the paper address the implications at two levels: 1. Opportunities where architecture and strategic urban interventions become catalysts for sustainable practices. 2. Insights and outcomes from this pedagogical approach to sustainable architectural design education. Developments on conflicted sites are laden with social, ethical, political and environmental concerns that intensify the environment and often contradict with sustainable development and intelligent environmental performance. The design studios explored in this paper challenge the traditional approach (in both academia and practice) of considering efficiency or technical building environmental performance in isolation. They offer opportunities for deploying design thinking in a strategic manner to develop resilient architecture in the context of climate change and current debates.

Keywords: Resilience; agency; architecture; education.

1. Introduction

The central role of the design studio at the core of architectural education is universally accepted across most schools of architecture (Oh et al., 2012); as is the potential for a studio teaching approach to encourage reflection (Schon, 1985; Green and Bonollo, 2003). Against concerns to integrate environmental studies into studio teaching, and make the discipline area more appealing to students (AIA, 2006), Thomas (2009) has argued for the value of an alternate approach to architectural design studio teaching where the objectives of the discipline are primary drivers within the studio.

Questions of sustainability and environmental consequences pervade most aspects of our lives. In architectural practice, they influence our building regulations and our energy codes. They are embedded in our criteria for architectural awards, and of course our education policy and school curricula. At the University of Technology Sydney (UTS), the building blocks of architectural science are delivered through a suite of three core compulsory subjects (each a quarter of a full semester load). The strand begins by

framing global imperatives for sustainability, and progresses to develop an understanding of human comfort, climate responsive design, advanced environmental control, lighting, acoustics, and integration of building services. Students learn to work with specialists from different disciplines and reconcile the competing environmental and program requirements in their design projects. This approach where technology courses operate to extend the resolution of the concurrent design studio project is not uncommon in many architectural schools. While the principles of architectural science are considered to be done and dusted on completion of the core subjects, a few schools offer specialist design studios with an environmental focus. Traditionally, dedicated environmental studios have looked to the tectonic integration of elements within architecture to ensure energy efficiency or technical building environmental performance. As digital tools for performance analysis in engineering and construction gain prominence, studios such as Hensel (2013), Guzowski (2013) and Thomas (2009) have also sought to emphasise digital processes beyond mere form making into the realm of performative design.

A purely techno-centric focus on facades in green buildings or water and energy efficiencies often continues to fuel growth and consumption. It turns out (surprisingly for some) that technology cannot fix every one of our problems. A more holistic view of sustainability recognises it to be a WICKED problem. Wicked problems as characterised by Rittel and Webber (1973) have complex interdependencies with no “solutions” in the sense of objective or definitive answers. This issue is further intensified in the context in which architecture operates, where the production and design of objects including buildings generates further consumption. Nevertheless the potential exists for design thinking to influence the way we approach this conundrum (Papanek, 1995; Hocking, 2010), enabling us to posit questions such as: *How do we embed sustainable practice in our buildings? Can design motivate or instigate sustainable habits or expectations? How do we future proof our cities and our buildings?*

While the remit of the architect is being increasingly marginalized in favour of other professions (Bennetts, 2008), this paper argues that addressing questions such as those posed above is crucial for the future of the profession especially in the context of climate change, urban expansion and evolving technology. Using the case study of architectural design studio investigations in the Master of Architecture course at UTS on conflicted sites in Australia where urban, economic, social, environmental and climate challenges are intensified, the paper address the implications at two levels: 1. Opportunities where architecture and strategic urban interventions can become the catalysts for sustainable practices. 2. Insights and outcomes from this pedagogical approach to sustainable architectural design education.

2. Studio Approach and Framework

The selective studios in the Master of Architecture at UTS emphasise modes of practising in architectural design with specific sub discipline objectives (such as technology, environment, and urban) as well as broader ambitions around the creative processes of architectural design. UTS has more recently framed studio investigations under a school wide theme (Burke, 2012). This paper discusses the pedagogical framework developed by the author for four recent studio iterations (2011-14) within the environmental studies theme offered at UTS. The first three of these iterations were developed and offered as part of an EU-Australia Joint Mobility Project¹ “Designing the New World: Developing Architectural Education in Response to Climate Change” (DARC).

¹ During 2011-13, UTS was part of DARC - a 6 university consortium (led by RMIT, with UTS & QUT from Australia & ETSA Barcelona, ENSA Toulouse, and Politecnico di Torino from Europe) that was awarded the mobility grant for staff and students.

2.1. Studio approach – the notion of the contested site

A core theme of the studios under discussion was the focus on conflicted sites in Australia. Developments on such sites are laden with social, ethical, political and environmental concerns that can sometimes contradict with sustainable development. Analysis of these conditions has the potential to provide critical insights for preparing for and responding to change. In addition they serve as a vehicle to drive research and design for sustainability at regional and precinct level.

From a pedagogical perspective, the real context of the site serves to encourage students' engagement with the multi scalar and trans-disciplinary nature of sustainable design. Previous studio iterations that focused on everyday situation in the city had led to valid and competent outcomes. However a reflection on those outcomes indicated that many students were content to mirror tried and tested solutions and struggled to challenge the status quo or posit an alternate future. By directing attention to conflicted sites with a remit for sustainability it was hoped that they would address pressing and contemporary concerns that affect all Australians – issues that appear daily in the news. More importantly the extreme, intensified nature of the condition was intended to push student thinking beyond the comfort of the "mixed use development and transit oriented design" framework to understand and respond innovatively to the conundrum of sustainability.

A key question for the studio was whether or to what extent an architectural intervention or proposition could be a catalyst for sustainability. The studio aimed to answer this from the context specificity of the condition, as well as through wider research and application of alternate possibilities. The contexts of two sets of iterations around the notion of contested sites are discussed below.

2.1.1. *Extreme Architecture, Roma 2011 and Trouble in Paradise, Curtis Island 2012*

The first studio focused on Roma, a small agricultural based town with a population of 6000, in Queensland. The town was facing a powerful rupture in economic and social continuity, through unprecedented rapid investment in coal seam gas (CSG) mining and large-scale recruitment of a fly-in, fly-out (FIFO) workforce of approximately 2000. A second studio iteration focused on the other end of the gas pipeline at a section of Curtis Island (near Gladstone). The island is part of the Great Barrier Reef marine park and soon to be the site of four LNPG plants where extracted gas is refined before being shipped offshore. The two studios investigated how architectural agency and research can drive opportunistic approaches to developing long-term sustainability of the towns whose economy was suddenly becoming heavily dependent on a booming energy intensive yet limited lifespan industry.

2.1.2. *Refining Kurnell 2013 and Refuelling Kurnell 2014*

The return to the city as the site of resource consumption generated two iterations of a studio focused around the now decommissioned Caltex Oil refinery at Kurnell Peninsula in Botany Bay. Situated at the fringe of the city at Sydney's busiest marine transport hub, it is flanked by national park and industry sitting alongside expanding residential communities and remnant infrastructure. Both studios were framed on the premise that in the short term Caltex' stated plans to redevelop parts of the refinery site for refined oil storage would continue. With input from real world stakeholders at Caltex, Sutherland Shire Council and community and action groups, both iterations required students to formulate a position for the future of the precinct and develop supporting design proposals.

2.2. Studio framework

Within the framework of investigative research the studios developed mapping as a design tool for the first five weeks, leading to student development of a comprehensive ‘intelligent brief’ and detailing of an architectural intervention in the remaining nine weeks. Each studio cohort comprised 18-19 students who worked with two studio tutors including the author.

2.2.1. Design and research in the studio

Salomon (2011) in his discussion on the rise of the research studio in architecture schools proposes that they have an ability to simultaneously engage with extra disciplinary issues while combining design and research to produce creative processes and artefacts. He suggests they need to commit to “practicing rigorous systematic and self-conscious methods and to producing results recognised as original and significant beyond their immediate context.” The UTS studio used the process of mapping as an investigative tool to enable documentation and understanding of the site in different ways, leading to strategic propositions. Mapping processes required both an analytical and suggestive practice (after Corner, 1999). Students worked in sub-groups of 4-5 to develop a detailed understanding of the *stasis flux* and possible *futures* of the project using a series of lenses appropriate to each studio. A key outcome was a comprehensive set of critical diagrams and drawings to synthesise and explain the complexities of the site and its relation to the immediate precinct and region/metropolis. In her essay reflecting on the Refining Kurnell studio, co-tutor Holliday (2014) describes how maps were used in the studio environment.

“Maps for our purposes were considered useful when they offered an opinion, when they suggested an argument or a way forward in order to identify an opportunity for architectural intervention. Maps were... lenses through which... projects would emerge”.

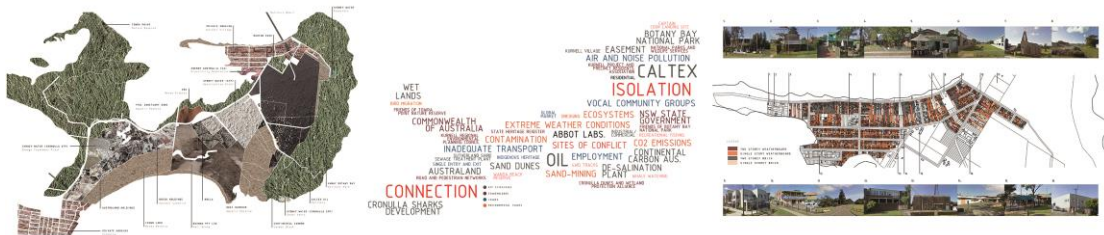


Figure 1. Student analytical mapping of Kurnell Peninsula, showing land use, conflicts and opportunities. (Source: M.Arch Studio Project - Salinas, E., Yeoh, J.L., Yeung, C.A., Chow, L.H., Gatesoupe, A., 2013)

A major challenge is how to encourage students' engagement with the trans-disciplinary nature of sustainable design given their limited experience of many of the issues at hand within the constraints of the 13-week semester. A process of careful design and preparation prior to commencement was implemented to alleviate this. This involved extensive background research, engaging with and attracting the right stakeholders, experts and resources to facilitate student learning as well as staging the studio through weekly learning activities, stakeholder workshops and specialist lectures.

2.2.2. Towards the idea of the “intelligent brief” or “strategic intervention” and design development

Rather than focus on a large scale “master-planning” of the “site”, the studios worked at the scale of strategic architectural interventions that could be instrumental in achieving the aspirations of the studio. Commencing in the latter part (Week 4 onwards) of the mapping and research phase, individuals or groups of students worked to develop their position on the condition and formulate their proposal.

Students were encouraged to harness organizational, environmental, social, programmatic and spatial intelligence when framing their proposition and developing their architectural design. They were challenged to rethink the nature of environmental performance, and shift from considering building efficiency in isolation to the nature of resilient architecture and urban interventions. Questions they grappled with included: *What is the nature of the “intervention” and “program” that can harness opportunities and constraints to redress the imbalance seen at this contested site? How can one achieve more by building less? How does a better understanding of stakeholders and their requirements affect program, zoning, layout, form across the multiple components? How can we innovate and explore new ways of working, shared programming and precinct level strategies for water, waste and energy?* This interrogation led to the formulation of “an intelligent brief” for diverse and creative propositions. Students presented their return brief with schedule of areas, program uses and performative criteria to measure the success of their individual development at the midpoint of the semester.

As students responded to the challenges of social and community needs, renewal, growth, consumption and climate change, they were expected to formulate criteria to satisfy key objectives for performance, resilience and sustainability. While core considerations included site sensitivity and appropriateness, building performance, safety, comfort and ‘quality’ indoor and outdoor space, students also detailed at least one of the following: life cycle and flexibility, ecological impact of materials, water conservation and reuse, net Zero Carbon Energy and eco-positive solutions, sustainable transport and pedestrians.

3. Studio outcomes

As a result of the studio methodology, outcomes were both unexpected and provocative. Students explored questions of valuing environmental and social capital and sustainability, and forged projects that can be catalysts for change in the communities in which they were situated.

At Roma, stakeholders (local government and mining companies) had assumed the emerging studio projects would be about low embodied energy or energy efficient/comfortable worker accommodation, or medium density housing proposals to combat the town’s housing shortage. However the mapping and (offsite) research uncovered the flow and carbon footprint of the FIFO cycle, the limited spatial interface between temporary workers and permanent residents, a sense of two-speed economy affecting the social fabric and the extreme condition of flood and drought in the region apart from its remoteness from other centres. This yielded a number of sophisticated proposals, with funding models capitalising on the obligations of mining companies and governments to provide social and environmental infrastructure. As an example, one project developed simple infrastructure for the year-long activation of the local showground (typically used twice a year) to promote interaction between locals, tourists and FIFO workers and provide an emergency services base during the region’s recurring floods. Programming events enabled transition from small group education and training to large regional crowd events. The built form integrated shading, energy generation, water management and flood mitigation.

In the Kurnell studios, students developed a narrative for the precinct by overlaying independent research findings with reflections from their interactions with stakeholders. The mapping exercises

uncovered hidden layers of Kurnell - its history, geography, unique biodiversity and a strong sense of community rarely found in other parts of Sydney. Significantly, the studios allowed particular examination of post-industrial brownfield sites and the largely untapped opportunity they offer to reimagine the future of our cities. As industry shifts off-shore and large tracts of land become available for alternate development, pre-existing infrastructure at such sites ensures ready-made access to roads, energy water and other services. The growth of the city often engulfs sites within proximity of the CBD and attracts large investment in medium and high-density housing. Thoughtless developments on such sites are critiqued (Langhorst, 2014) for using the sustainability banner of regeneration and renewal to rationalise neoliberal development and fuel further consumption. These sites themselves are not without challenges, particularly toxic contamination of the land from previous industrial use.



Figure 2. Studio project for hydroponic fish farm and market garden at Kurnell.
(Source: M.Arch Studio Project - Oh, S., 2013)

The mapping and research served as a platform for further investigation of urban themes to shape individual propositions for the site. Project outcomes demonstrated the opportunity to remediate remnant refinery infrastructure and contaminated land, and reimagine a sustainable future for the Caltex site by introducing new uses and community focus spaces within the precinct. In the 2013 iteration, a number of projects explored ideas for energy and food security such as algal biofuel farms, fish farming, and an aquaponic farm with microbrewery and biogas plant (Figure 2). Other proposals promoted sport, recreation and cultural performance by linking the Caltex precinct to neighbouring national park, wetland and tourist sites such as Captain Cooks Landing and whale watching outposts. While projects for scientific research facilities harnessed the existing intensity of high-tech infrastructure onsite, a few provocative projects sought to negotiate the tricky terrain of the contested edge, mediating restricted access to concurrent Caltex operations while affording substantive opportunities for passive surveillance of contained processes for remediation.

The 2014 iteration emphasised the importance of the site as high value employment land with a core brief for a research centre of excellence to trigger co-programs. One comprehensive proposition (Figure 3) used a premise of increased population density and reinstatement of the ferry connection to close the loop from Little Bay and connect the precinct to other centres of growth. The campus proposal was placed as the catalyst at the core of the former refinery, positing the post-oil transformation of the fuel import site into a high tech employment research/residential precinct supported by on-site bio-energy, food production and waste treatment. Other groups explored redevelopment that was integrated with a carefully staged process of bioremediation and constructed wetlands, the concept of the outdoor city and questions of blurring the contested edge between the existing Kurnell village and institutional use.

Individual projects (Figure 4 and Figure 5) enabled an exposition of the overarching propositions through architectural development. The imperative for architectural and aesthetic resolution of the

brief emphasised metrics such as reduction of floor space (and embodied energy) through shared programming, sizing of food production or bio energy potential, flow charts for inventive co-production workshops, integrated bio remediation, water and site sensitive design and material selection over energy simulation or heat balance calculations.



Figure 3. Student group precinct strategy for the post-oil transformation of fuel import site at Kurnell. (Source: M.Arch Studio Project - Capparelli, J., Ferriere, M., Kacha, K., Trudeau, T., Zarsav, S., 2014).

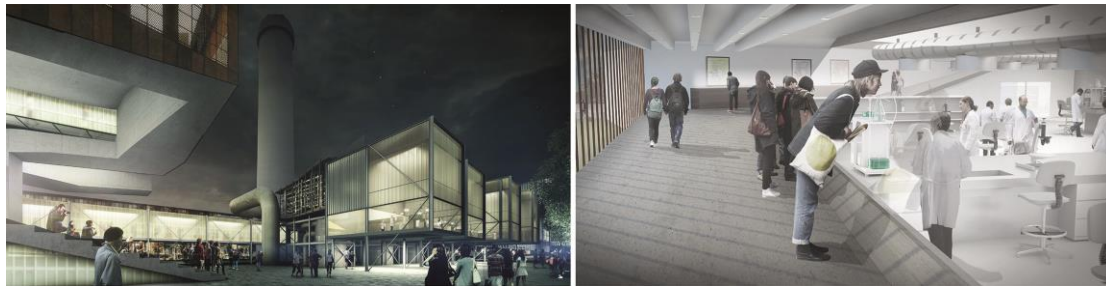


Figure 4. Individual designs for Kurnell, showing art galleries, public omni theatre (left), exploratory walkway and scientific research facility (right). (Source: M.Arch Studio Project - Caparelli, J., and Kelly, J., 2014)

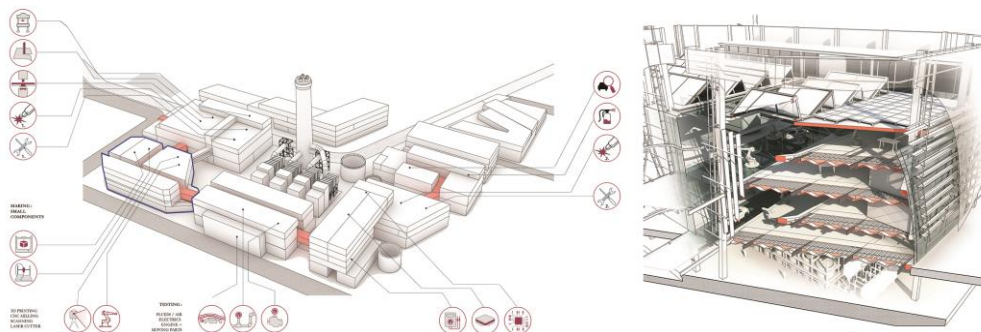


Figure 5. Student design for solar powered car factory at Kurnell, including detailed scheme for the co-production of manufactured goods flowing through multiple structures. (Source: M.Arch Studio Project - Trudeau, T., 2014)

4. Reflection on studio process and outcome

4.1. Evaluation of effectiveness of student learning

Criterion referenced assessment was used to assess the effectiveness of the learning outcomes throughout the studio. Milestone submissions via design jury with internal staff and guest critics were supplemented with staged process submissions, a reflective journal and final portfolio exposition. In addition to formal and informal assessments, final studio outputs in the first three iterations were subject to charrettes as part of the 6 university DARC Mobility grant. This provided an opportunity for a two way learning process for the local and exchange students and staff from the six participating universities. Through the charettes, staff and students were able to separately disseminate the outcomes to company, council and community stakeholders. Outputs were well received by the stakeholder groups, particularly the use of mapping and precinct strategy as a method for understanding and visualising stasis, flux and future(s). The quality of outputs prompted production of a booklet showcasing them for future students, and the stakeholder group.

Student feedback on their learning was positive with objectives, assessment, feedback, resources, overall quality and teaching generally averaging over 4.0 on a 5 point scale (1=Strongly Disagree and 5=Strongly Agree). Students by and large found the studio and its framework *“interesting and challenging” “intellectually stimulating”* and *“outside the box”*. In the first iteration, students noted their early struggle with the quantum of research and mapping *“quite a lot for one week to investigate about the whole ecology”*. This was remedied in subsequent iterations through more carefully design (see 2.2.1) to facilitate learning and leave adequate time for detail design development. Students noted *“To think beyond architecture and at a precinct scale definitely made the learning experience of the studio much more interesting where design decisions were based on satisfying both the micro and macro scales”*. In the author’s view, the emphasis varies with each iteration - given the constraints of the 13 week semester, a first iteration on a complex condition of this nature calls for different kind of project expectations compared to a second studio on the same site that builds on the research of the first.

4.2. Collaborative and designerly approaches for integrating sustainability

The collaborative benefits of working in groups and managing this are well recognized. Group work was critical to effectively manage the swathe of background research in an investigative studio of this nature. It also enabled students to develop and contribute specialist skills within the team and more importantly benefit from teaching and learning from one another.

With current concerns regarding climate change and the ever widening scope of architectural curriculum content, the argument for colocation of disciplinary content within the studio is compelling. However an aspect of integration that is less talked about centres around teaching staff and expertise. In too many schools, teaching staff with sustainability expertise come in as specialists and their view does not always have buy in from all design tutors. In contrast, a key feature of the studios presented here is the complementary expertise of the teaching team - in each instance, both tutors had architectural training and a strong interest in sustainability and design process. While one specialised in environmental performance evaluation and user studies, the other came from an urban design architectural practice background. This was augmented with specialist expertise sourced from outside (see 2.2.1). Although this appears to be a resource intensive way of teaching, it is valued in the school as means of engaging in research and debate about the role of architecture in the future of our cities.

If questions of sustainability are to be taken seriously, it is important that students see and know this - not only through stated brief requirements and assessment criteria but also in terms of how the issues are naturally part of the day to day concerns of the studio. In the author's view, expertise in the field must be intrinsically located within the studio. In other words "architectural science" staff must not be reticent about offering and directing serious studio options. However as Lawson (2004) notes, students will find it hard to "connect and use the theoretical knowledge when actually designing" (p 105) unless knowledge has been taught in a way that is designerly. If studio options are to be valued by students, the studios must adopt a designerly approach to sustainability and capture their imagination even if it does throw students out of their comfort zone. The studio framework as set out in section 2 aimed to achieve these objectives, and in the authors' view demonstrates one way in which this can be pursued.

4. Concluding discussion

An integrated approach to architectural design pedagogy is needed in order to produce graduates capable of synthesising the array of complex considerations they will confront. From a disciplinary perspective, the studios subscribe to the importance of using design to effect an eco-positive future (Birkeland, 2008). The outcomes did not sit squarely in any one of the six competing logics of sustainability, from technology to cultural and social, as characterised by Guy and Farmer (2011), but aimed to mediate these boundaries. The approach concurs with their position that

"If the future direction and success of sustainable architecture strategies relies on the abilities of architects to act as moral citizens by engaging in an open process of negotiation, criticism and debate... it's vital that students are encouraged to become more sensitive to the range of possible logics of innovation that may surface in design practice."

It is acknowledged that some aspects of the studio model described are not easily replicable everywhere – as noted, resource implications can be onerous and must be supported by the schools. Additionally, outcomes can be enriched and workload can be managed by capitalising on groundwork and results of the past studios to develop subsequent iterations, as well as fostering a team of teaching staff able to work collaboratively. Furthermore, encouraging academics to develop research-led teaching programs in their area of expertise can mitigate competing demands for teaching and research outcomes while exploiting design studios as potential sites for real and speculative investigation.

This paper argues that analysis of the specific conditions of conflicted sites, where urban, economic, social and environmental and climate challenges are intensified, offers the opportunity to prepare graduates able to respond to change. The design studios explored in this paper **simultaneously** serve as a vehicle to drive research and opportunistic approaches to sustainability at regional and precinct level and challenge the traditional approach of considering efficiency or technical building environmental performance in isolation. The studio model highlights opportunities for deploying design thinking strategically to develop resilient architecture in the context of climate change and current debates.

Acknowledgements

The studio outputs stem from the enthusiasm, curiosity and creativity of participating UTS Master of Architecture students from 2011 to 2014. The intellectual framework for the studios was developed by the author who was ably supported by studio tutors Jarrod Lamshed (2011, 2014) David Neustein (2012) and Amelia Holliday (2013) and research assistants Jillian Hopkins (2013-14) and Chantel Carr (2011). We acknowledge the invaluable resources and briefing provided for the studio by stakeholder

organizations including Santos, Caltex, Sutherland Shire Council, Maranoa Regional Council staff, and community members at Kurnell, Gladstone and Roma. Funding through the EU-Australia Joint Mobility Project “Designing the New World: Developing Architectural Education in Response to Climate Change” (DARC) enabled an exchange of ideas around resilience and pedagogy with participating universities.

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